

Minutes & Slides from Proton Driver RF Meeting Sept 21, 2004

(G.W. Foster)

Subjects: Circulator tests, Thales Visit, YIG Tuner Status, 325 MHz RF System R&D

Attendees: Ding Sun, Bob Kustom, Dave Wildman, Al Moretti, Victor Yarba, Brian Chase, Milorad Popovic, Bob Kephart, G.W. Foster.

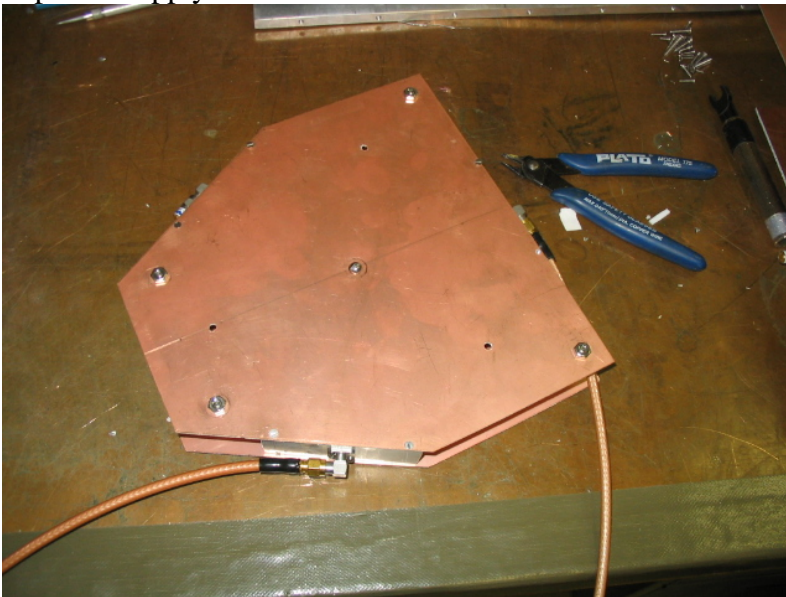
**** Next Meeting September 28th ****

MINUTES

CIRCULATOR TESTS

Ding Sun discussed his successful first tests of a circulator built from the YIG ferrite discs (3" OD x 0.5" ID x 0.5" thick) used for the coax tuners. This is a prototype for one of the components to be used on the "microstrip-line circuit board IQ Modulator module" which contains the circulator, load, branch-line hybrids and ferrite stub tuners needed for resonance control on a low-power SCRF cavity.

The circulator is a pair of YIG disks with a copper sheet between them, three stripline connections to the center conductor spaced at 120 degrees, inside a copper box which forms the ground plane of the stripline connections. A magnetic bias field was applied parallel to the axis of the YIG disks using George Krafczyk's Main Injector horizontal corrector magnet & power supply.



Ding tried two configurations, both with and without a shorting conductor through the center of the YIG disc. Without the short, he measured a best operating frequency of 565 MHz, isolation of ~ -30db, insertion loss is -0.1 to -0.2 db., and band width of 17 MHz (at isolation of -20 db). These are in good agreement with the simulations, and comparable to commercially available circulators.

With the shorted installed through the center of the discs, the circulator worked almost as well and the best operating frequency dropped to ~350 MHz. This is a promising strategy for making a dinky, medium-performance circulator.

FAST COAX TUNER

Dave Wildman has received the “fast” version of the coax tuner, including the fast bias coil and ferrite flux return, back from Vladimir Kashikhin of the Tech Division. He is now waiting for a pulsed power supply, which Steve Hays is putting together in between NUMI adventures.



Dave is also discussing the possibility of doing full-power tests of tuners, hybrids, circulator, etc. at the ANL/APS 352 MHz klystron test stand. The Klystron can make 1 MW CW and can be modulated to our 1.5% duty cycle.

TESTS OF SRF SPOKE CAVITIES IN PULSED MODE

Bob Kustom is investigating the possibility of testing a RIA 345MHz spoke resonator in the same 1 MW 352 MHz Klystron test stand at the APS. There is a small test cryostat with a prototype RIA spoke resonator in it which could be moved to the Klystron test area and operated with helium dewars. A first question is how much power the Klystron puts out when you try driving it at 345 MHz. This will be tested in the next couple of weeks. We need at least 50kW or so to make interesting tests on the resonators. If the Klystron doesn't work well, we can still use the Klystron to make interesting tests of the power couplers.

325 MHz FRONT-END LINAC RF SYSTEM DESIGN OPTIONS

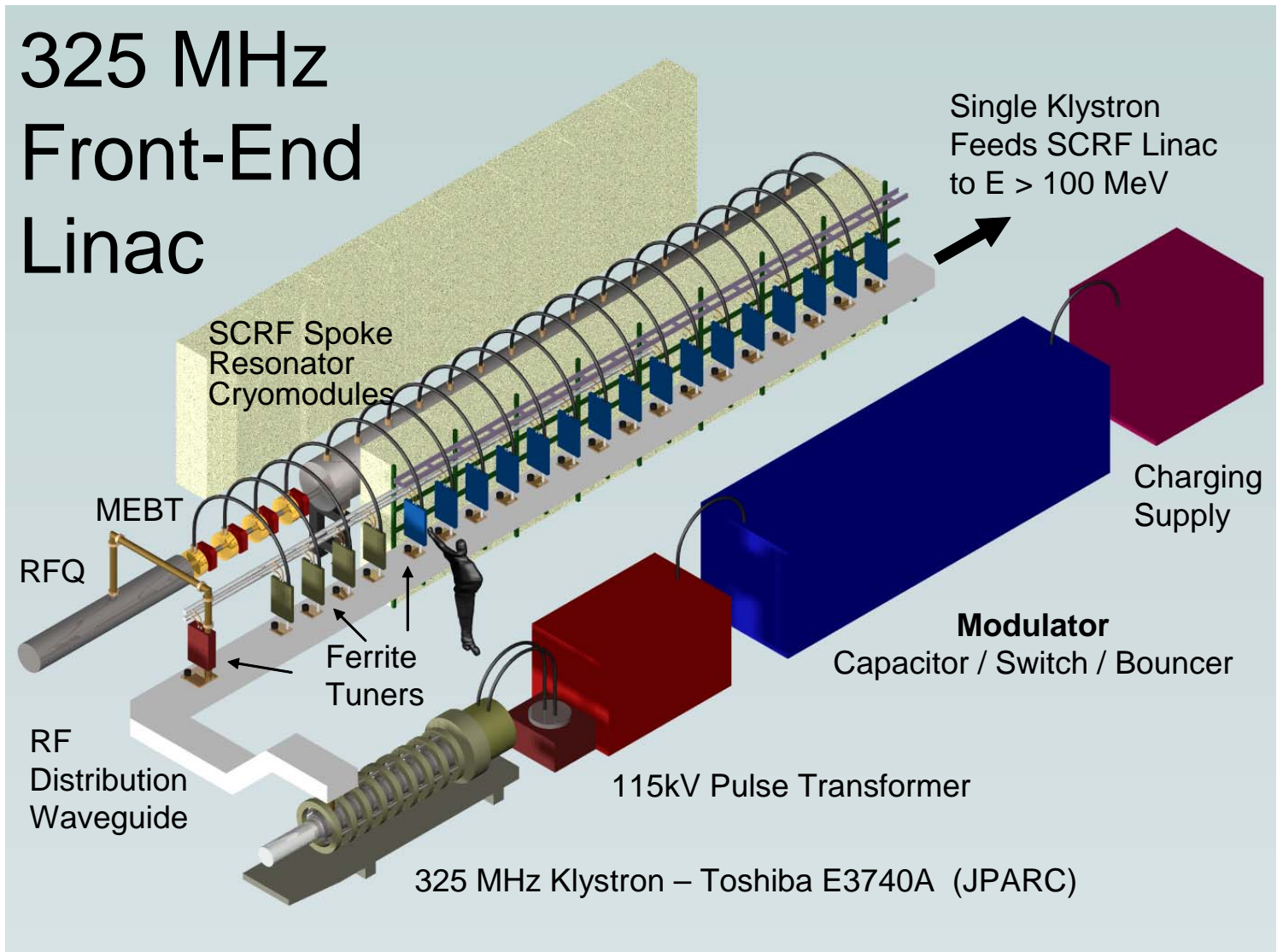
Bob Kustom has been evaluating, laying out, and cost-estimating various options for the 325MHz front end linac RF system. Three designs have been looked at:

- 1) The RF power is split from single large Klystron to individual cavities with a sequence of waveguide hybrids, circulators, and radial power combiners/splitters. Power is fed to each cavity via circulators and IQ modulators with ferrite tuning stubs. A rather complete layout

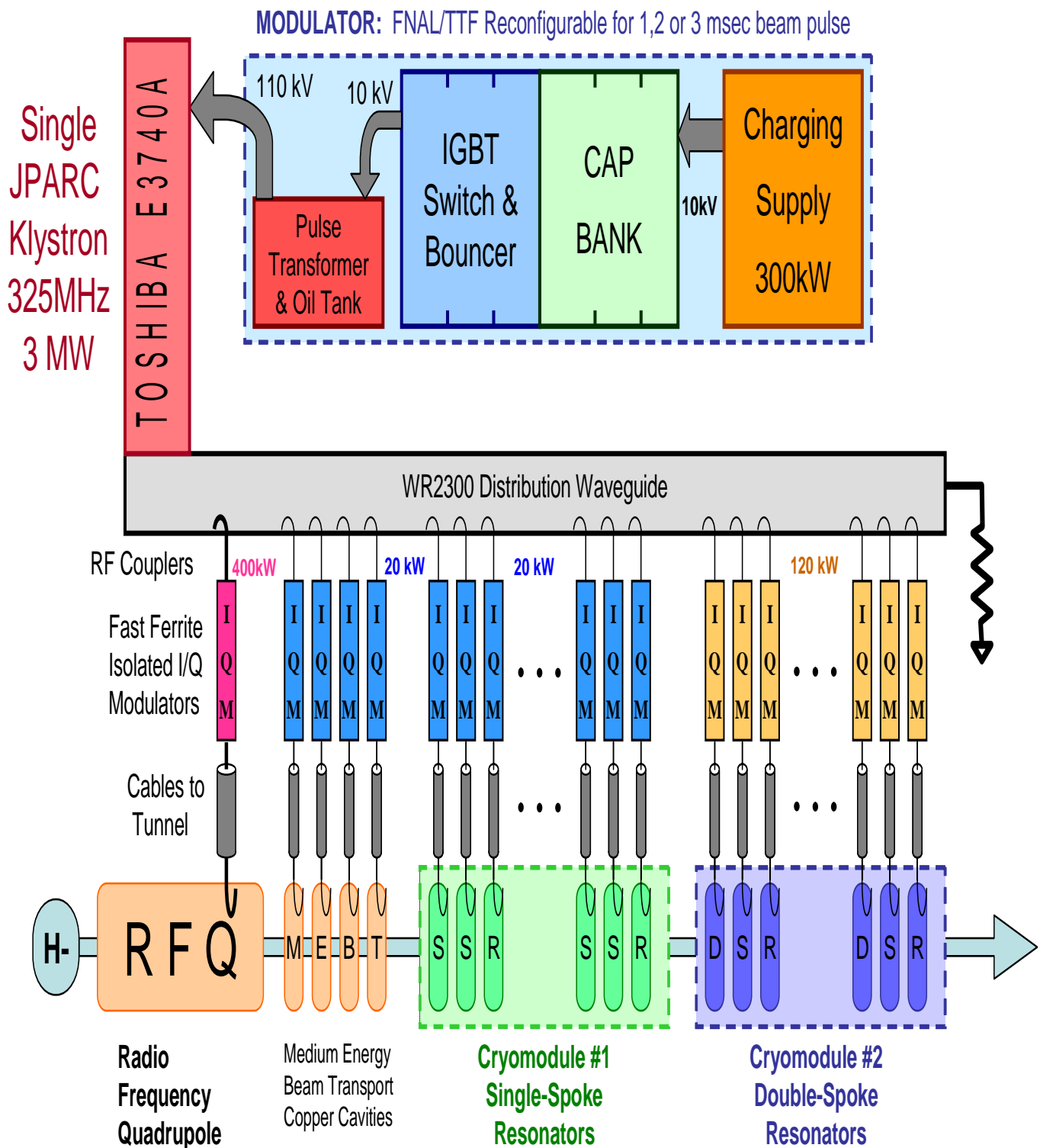
and cost estimate has been generated for this option, which appears to have no technical difficulties.

2) A TESLA-like scheme in which the large Klystron drives a single long waveguide running the length of the linac. Power is split off via directional couplers, then sent to each cavity via circulator/isolators and IQ modulators with ferrite tuning stubs. The hope is to build a single module containing all three elements. These modules could be built on circuit boards at low power levels and with hard line coax and higher power levels. The cabling and layout of this scheme is simpler and cheaper than other schemes, and this is the preferred scheme at present

3) A one-tube-per-cavity design, using tetrodes or IOT's, with a common bulk supply to save costs. Because of the number of SRF resonators, 60-100 tubes would be needed, maybe more if two stages of drive tubes are needed for the high-power channels. It appears that the cost of this system will be higher than one which splits the power from a single Klystron.



325 MHz RF System



325 MHz FRONT-END LINAC R&D PLAN

Bill Foster led a general discussion of the R&D plan for the front-end linac. If we go full speed ahead on the modulator & 325 MHz Klystron, there is still about a year before these are available for tests. In the interim, possible R&D steps include:

- a) continue prototyping the Ferrite IQ modulators, first as individual components, then at increasing power levels. The ANL 352 MHz test stand might be used, on a time-to-time basis, for these tests. Goal is within a year to have prototypes of full-spec modules at each required power level (5kW, 20kW, 80kW, (& 180kW for 3-spokes)).
- b) Prototype the wave guide power split at low power levels. Characterize the crosstalk between coupling loops, etc., and compare with simulation.
- c) Develop detailed LLRF simulations to verify the IQ modulator speed requirements. Build & test a few channels of ferrite IQ modulator control electronics.
- d) Obtain a copy of the JPARC RFQ.
- e) Build a useable H- source. & MEBT components, and a beam diagnostics box, possibly in collaboration with NIU.
- f) Get one single-cryomodule cavity plumbed into the Helium system at Meson.

The minutes of the RF meetings are online at:

http://tdserver1.fnal.gov/8gevinacPapers/Meeting_Minutes/RF/Index.html